

A208.3 Erosion & Sediment Control Checklist**Erosion & Sediment Control Checklist**

Minimum Standards – All applicable Minimum Standards must be addressed.

1. Permanent or temporary soil stabilization shall be applied to denuded areas within seven days after final grade is reached on any portion of the site. Temporary soil stabilization shall be applied within seven days to denuded areas that may not be at final grade but will remain dormant for longer than 30 days. Permanent stabilization shall be applied to areas that are to be left dormant for more than one year.
2. During construction of the project, soil stock piles and borrow areas shall be stabilized or protected with sediment trapping measures. The applicant is responsible for the temporary protection and permanent stabilization of all soil stockpiles on site as well as borrow areas and soil intentionally transported from the project site.
3. A permanent vegetative cover shall be established on denuded areas not otherwise permanently stabilized. Permanent vegetation shall not be considered established until a ground cover is achieved that is uniform, mature enough to survive and will inhibit erosion.
4. Sediment basins and traps, perimeter dikes, sediment barriers and other measures intended to trap sediment shall be constructed as a first step in any land-disturbing activity and shall be made functional before upslope land disturbance takes place.
5. Stabilization measures shall be applied to earthen structures such as dams, dikes and diversions immediately after installation.
6. Sediment traps and sediment basins shall be designed and constructed based upon the total drainage area to be served by the trap or basin.
 - a. The minimum storage capacity of a sediment trap shall be 134 cubic yards per acre of drainage area and the trap shall only control drainage areas less than three acres.
 - b. Surface runoff from disturbed areas that is comprised of flow from drainage areas greater than or equal to three acres shall be controlled by a sediment basin. The minimum storage capacity of a sediment basin shall be 134 cubic yards per acre of drainage area. The outfall system shall, at a minimum, maintain the structural integrity of the basin during a 25-year storm of 24-hour duration. Runoff coefficients used in runoff calculations shall correspond to a bare earth condition or those conditions expected to exist while the sediment basin is utilized.
7. Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion. Slopes that are found to be eroding excessively within one year of permanent stabilization shall be provided with additional slope stabilizing measures until the problem is corrected.
8. Concentrated runoff shall not flow down cut or fill slopes unless contained within an adequate temporary or permanent channel, flume or slope drain structure.

9. Whenever water seeps from a slope face, adequate drainage or other protection shall be provided.
10. All storm sewer inlets that are made operable during construction shall be protected so that sediment-laden water cannot enter the conveyance system without first being filtered or otherwise treated to remove sediment.
11. Before newly constructed stormwater conveyance channels or pipes are made operational, adequate outlet protection and any required temporary or permanent channel lining shall be installed in both the conveyance channel and receiving channel.
12. When work in a live watercourse is performed, precautions shall be taken to minimize encroachment, control sediment transport and stabilize the work area to the greatest extent possible during construction. Nonrodible material shall be used for the construction of causeways and cofferdams. Earthen fill may be used for these structures if armored by nonrodible cover materials.
13. When a live watercourse must be crossed by construction vehicles more than twice in any six-month period, a temporary vehicular stream crossing constructed of nonrodible material shall be provided.
14. All applicable federal, state and local chapters pertaining to working in or crossing live watercourses shall be met.
15. The bed and banks of a watercourse shall be stabilized immediately after work in the watercourse is completed.
16. Underground utility lines shall be installed in accordance with the following standards in addition to other applicable criteria:
 - a. No more than 500 linear feet of trench may be opened at one time.
 - b. Excavated material shall be placed on the uphill side of trenches.
 - c. Effluent from dewatering operations shall be filtered or passed through an approved sediment trapping device, or both, and discharged in a manner that does not adversely affect flowing streams or off-site property.
 - d. Material used for backfilling trenches shall be properly compacted in order to minimize erosion and promote stabilization.
 - e. Restabilization shall be accomplished in accordance with this chapter.
 - f. Applicable safety chapters shall be complied with.
17. Where construction vehicle access routes intersect paved or public roads, provisions shall be made to minimize the transport of sediment by vehicular tracking onto the paved surface. Where sediment is transported onto a paved or public road surface, the road surface shall be cleaned thoroughly at the end of each day. Sediment shall be removed from the roads by shoveling or

sweeping and transported to a sediment control disposal area. Street washing shall be allowed only after sediment is removed in this manner. This provision shall apply to individual development lots as well as to larger land-disturbing activities.

18. All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization or after the temporary measures are no longer needed, unless otherwise authorized by the local program authority. Trapped sediment and the disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion and sedimentation.

19. Properties and waterways downstream from development sites shall be protected from sediment deposition, erosion and damage due to increases in volume, velocity and peak flow rate of stormwater runoff for the stated frequency storm of 24-hour duration in accordance with the following standards and criteria:

a. Concentrated stormwater runoff leaving a development site shall be discharged directly into an adequate natural or man-made receiving channel, pipe or storm sewer system. For those sites where runoff is discharged into a pipe or pipe system, downstream stability analyses at the outfall of the pipe or pipe system shall be performed.

b. Adequacy of all channels and pipes shall be verified in the following manner:

(1) The applicant shall demonstrate that the total drainage area to the point of analysis within the channel is one hundred times greater than the contributing drainage area of the project in question; or

(2)(a) Natural channels shall be analyzed by the use of a two-year storm to verify that stormwater will not overtop channel banks nor cause erosion of channel bed or banks.

(b) All previously constructed man-made channels shall be analyzed by the use of a ten-year storm to verify that stormwater will not overtop its banks and by the use of a two-year storm to demonstrate that stormwater will not cause erosion of channel bed or banks; and

(c) Pipes and storm sewer systems shall be analyzed by the use of a ten-year storm to verify that stormwater will be contained within the pipe or system.

c. If existing natural receiving channels or previously constructed man-made channels or pipes are not adequate, the applicant shall:

(1) Improve the channels to a condition where a ten-year storm will not overtop the banks and a two-year storm will not cause erosion to channel the bed or banks; or

(2) Improve the pipe or pipe system to a condition where the ten-year storm is contained within the appurtenances;

(3) Develop a site design that will not cause the pre-development peak runoff rate from a two-year storm to increase when runoff outfalls into a natural channel or will not cause the pre-development peak runoff rate from a ten-year storm to increase when runoff outfalls into a man-made channel; or

(4) Provide a combination of channel improvement, stormwater detention or other measures which is satisfactory to the plan approving authority to prevent downstream erosion.

d. The applicant shall provide evidence of permission to make the improvements.

e. All hydrologic analyses shall be based on the existing watershed characteristics and the ultimate development condition of the subject project.

f. If the applicant chooses an option that includes stormwater detention, he shall obtain approval from the locality of a plan for maintenance of the detention facilities. The plan shall set forth the maintenance requirements of the facility and the person responsible for performing the maintenance.

g. Outfall from a detention facility shall be discharged to a receiving channel, and energy dissipators shall be placed at the outfall of all detention facilities as necessary to provide a stabilized transistion from the facility to the receiving channel.

h. All on-site channels must be verified to be adequate.

i. Increased volumes of sheet flows that may cause erosion or sedimentation on adjacent property shall be diverted to a stable outlet, adequate channel, pipe or pipe system, or to a detention facility.

j. In applying these stormwater management criteria, individual lots or parcels in a residential, commercial or industrial development shall not be considered to be separate development projects. Instead, the development, as a whole, shall be considered to be a single development project. Hydrologic parameters that reflect the ultimate development condition shall be used in all engineering calculations.

k. All measures used to protect properties and waterways shall be employed in a manner which minimizes impacts on the physical, chemical and biological integrity of rivers, streams and other waters of the state.

Narrative Section:

_____ Project description – Briefly describe the nature and purpose of the land disturbing activity and the areas (acres) to be disturbed.

_____ Existing site conditions – A description of the existing topography, vegetation and drainage.

_____ Adjacent Areas – A description of neighboring areas such as streams, lakes, residential area, roads, etc., which might be affected by the land disturbance.

_____ Off-site areas – Describe any off-site, land disturbing activities that will occur (including borrow sites, waste or surplus areas, etc.) Will any other areas be disturbed? Identify stockpile areas.

_____ Soils - A brief description of the soils on the site giving such information as soil name, mapping unit, erodibility, permeability, depth, texture and soil structure.

_____ Critical areas – A description of areas on the site which have potentially serious erosion problems (e.g., steep slopes, channels, wet weather/ underground springs, etc.)

_____ Erosion and sediment control measures – A description of the methods which will be used to control erosion and sedimentation on the site. (Controls should meet the specifications in Chapter 3 of the *Virginia Erosion and Sediment Control Handbook*.)

_____ Permanent stabilization – A brief description, including specifications of how the site will be stabilized after construction is completed.

_____ Stormwater runoff considerations – Will the development site cause an increase in peak runoff rates? Will the increase in runoff cause flooding or channel degradation downstream? Describe the strategy to control stormwater runoff.

_____ Calculations – Detailed calculations for the design of temporary sediment basins, permanent stormwater detention basins, diversions, channels, etc. Include calculations for pre-development and post-development runoff.

Subdivision/Site Plan Section:

_____ Vicinity map – A small map locating the site in relation to the surrounding area. Include any landmarks which might assist in locating the site.

_____ Indicate north – The direction of north in relation to the site.

_____ Limits of clearing and grading – Areas which are to be cleared and graded.

_____ Existing contours – The existing contours of the site.

_____ Final contours – Changes to the existing contours, including final drainage patterns.

_____ Soils – The boundaries of different soil types.

_____ Existing drainage patterns – The dividing lines and the direction of flow for the different drainage areas. Include size (acreage) of each drainage area.

_____ Critical erosion areas – Areas with potentially serious erosion problems. (See Chapter 6 of the *Virginia Erosion and Sediment Control Handbook* for criteria.)

_____ Site Development – Show all improvements such as buildings, parking lots, access roads, utility construction, etc.

_____ Location of practices – The locations of erosion and sediment controls and stormwater management practices used on site. Use the standard symbols and abbreviations in Chapter 3 of the *Virginia Erosion and Sediment Control Handbook*

_____ Off-site areas – Identify any off-site land-disturbing activities (e.g., borrow sites, waste areas, etc.). Show location of erosion controls. (Is there sufficient information to assure adequate protection and stabilization?) Stockpiles?

_____ Detail drawings – Any structural practices used that are not referenced to the *Virginia Erosion and Sediment Control Handbook* or local handbooks should be explained and illustrated with detailed drawings.

_____ Maintenance – A schedule of regular inspections and repair of erosion and sediment control structures should be set forth.

_____ Overlay soils boundaries on the Phase 1 E&S Plan.

_____ Perimeter controls must include all utility work and trails.

_____ Construction entrances must be included at all access points.

_____ Roads and lots must be identified on both the Phase 1 and Phase 2 E&S Plan.

_____ The following information must be submitted when a Temporary Sediment Basin (Std. 3.14) is proposed for a project:

- _____ • Temporary Sediment Basin Design Data Sheets
- _____ • Time of Concentration flow path (broken up into sheet, shallow concentrated and channel flow). When a T_c of 5 minutes is used, the flow path is not required.
- _____ • Stage/storage elevation information
- _____ • When using TR-55, all worksheets must be included in submittal.
- _____ • When using the Modified Rational method (for drainage areas less than 20 acres) a “C” factor of 0.6 must be used.
- _____ • A schematic for each sediment basin must be provided showing dimensions and elevations.
- _____ • Show the length of the flow path from the inflow at the wet pool to the outflow to ensure that the length to width ratio is adequate.
- _____ • Emergency spillway dimensions and calculations.

_____ When micaceous soils are found on a site, rock check dams and silt fence should be used in conjunction with sediment traps and sediment basins in those areas.

_____ Sanitary sewer, water line and storm sewer must be shown on the Phase 2 E&S plan. Structure numbers must also be shown. While these are not required to be shown on the Phase 1 E&S plan, the perimeter E&S controls for Phase 1 must take the construction of these utilities into account.

_____ The E&S plan should be at a scale of at least 1” = 50’.

_____ Soil stockpiles and borrow areas must be identified on the plan.

_____ All stream crossings must be sized according to the specifications outlined in the *Virginia Erosion and Sediment Control Handbook*. Specifically, if a crossing is to remain in place up to 14 days, it must be sized to carry a 2 year storm. If a crossing is to remain in place for 14 days to 1 year, it must be sized to carry a 10 year storm. A profile of the crossing and all calculations used must be submitted.

A208.3 Technical Bulletins

Erosion & Sediment Control Technical Bulletin #1

Improving Soil Quality in Urbanizing Areas

Background

Typical development practices in urbanizing areas leave soils with greatly diminished soil quality on which to establish lawns and landscaped areas. In the course of development, soil rich in critical organic material is often stripped, compacted, buried under subsoil, or removed and replaced with shallower depths of lower quality imported soil or fill material. Existing soil quality can be conserved by preservation and reapplication of topsoil in accordance with the *Virginia Erosion & Sediment Control Handbook* (Std & Spec 3.29 and 3.30) at a minimum, or preferably, improved by adding organic matter through addition of compost. Compost is aerobically decomposed organic waste, such as animal manure, biosolids, and yard wastes, which has a long history of use as a tool to enhance degraded soils.

Increasing soil organic matter enhances the soils ability to support healthy vegetation and provides environmental and economic benefits. Further information beyond the basic benefits and recommendations outlined in this document is available from your local Conservation District, Virginia Cooperative Extension, NRCS, or DCR representative.

Benefits of Healthy Soil

- Absorbs more stormwater by increasing rainwater interception and infiltration, thereby reducing runoff, resultant erosion, and the need for costly collection and treatment BMPs.
- Reduces fertilizer, herbicide, and pesticide needs and resultant damage to water resources by:
 - Providing better nutrient holding capacity and availability, so that soils recycle nutrients over successive years in concert with the plants growth-cycle, and
 - Promoting growth of vigorous vegetation that out-competes weeds and filters sediment, chemicals, pathogens, and other contaminants before they reach surface or groundwater.
- Reduces irrigation requirements by improving moisture absorption and retention.
- Increases disease and drought resistance, and thus the lifespan of plants.
- Improved water quality aids recovery of aquatic species, and may eliminate need for costly restoration efforts.
- Encourages vigorous plants that enhance contractor's reputation and reduces call-backs.
- Healthy vegetation adds aesthetic value ("curb appeal") to properties and neighborhoods.
- Healthy plant systems purify and cool urban air.

Soil Establishment Recommendations

(1) *Retention* - The duff layer (leaves, twigs, detritus) and native topsoil should be retained in an undisturbed state to the maximum extent practicable. In any areas requiring grading, the duff layer and topsoil should be removed and stockpiled on site to be reapplied on their own, or preferably once amended with compost, to other portions of the site.

(2) *Quality* - All cleared and graded areas planned as landscaped areas or lawns **that are not** covered by impervious surface, part of a drainage facility, or engineered as structural fill or slopes (> 2:1) should demonstrate the following:

a) The moisture infiltration rate and soil moisture holding capacity of the original undisturbed soil native to the site should be retained or enhanced. Areas that have been compacted, or where duff or underlying topsoil is removed, should be amended with compost to mitigate for lost moisture infiltration and holding capacity.

b) A topsoil layer should be present that matches the conditions of the original undisturbed soil or has the following characteristics:

1. Minimum depth of 4 inches
2. pH from 6.0 to 7.0
3. Minimum organic content of 4% dry weight
4. Soluble salts < 500 ppm

c) Subsoils in areas with grades less than 3:1 should be scarified at least 4 inches below the topsoil layer (2 inches on slopes > 3:1) with some incorporation of upper material when feasible. Where regular construction traffic has passed, a subsoiler should be used to a depth of 4 feet to break up traffic paths.

Note that the resulting soil must be appropriate for the physiographic region, hydrology, and chosen vegetation.

(3) Maintenance

a) Soil should be protected from compaction, planted as soon as possible after installation, and mulched appropriately after planting.

b) Plant debris or its equivalent should be left on the soil surface to replenish organic matter.

c) Annual soil samples should be collected and analyzed to provide guidance on liming and fertility requirements to help maintain long-term soil and plant health.

Erosion & Sediment Control Technical Bulletin #2

APPLICATION OF ANIONIC POLYACRYLAMIDE FOR SOIL STABILIZATION AND STORMWATER MANAGEMENT

Introduction

Anionic polyacrylamide (Anionic PAM) is a non-toxic chemical material that is being marketed nationwide for controlling soil erosion and sedimentation on construction sites. Current independent research by state and federal institutions has indicated that application of Anionic PAM in conjunction with conventional erosion and sediment controls (seed, mulch, perimeter controls, sediment basins, etc.) can be a safe, effective, and economical (applied cost of ~\$100-\$300/acre) technique for addressing problem soils on construction sites, when compared to conventional ESC measures alone. This technical bulletin is **not** an official ESC State Standard & Specification or an endorsement of a specific Anionic PAM product; specifications advocated for land-disturbing activities are listed in Chapter 3 of the *Virginia Erosion & Sediment Control Handbook*. However, based on the recent number of inquiries regarding Anionic PAM and, most importantly, its potential to prevent off site damage and aid compliance with the Virginia Erosion & Sediment Control Regulations, this general guidance has been developed to assist land disturbers or plan-approving authorities that feel Anionic PAM may be beneficial to a specific site. Following further use and testing in Virginia, DCR may consider including an Anionic PAM specification in a future edition of the *Handbook*.

Background

“PAM” is a generic term for long-chain organic polymers that have been in use for many years as flocculating agents in wastewater treatment and food processing plants; furrow agriculture; mining separations; petroleum recovery; and personal care products. Extensive study has demonstrated that occupational exposure to *Anionic* PAM is **NON-TOXIC** when used as directed and is not a Federally listed hazardous compound; however, *Cationic* PAM is highly toxic to aquatic life and must **NEVER** be employed. Several states, NRCS, and EPA have recently completed guidance on the use of Anionic PAM for sediment control on agricultural and construction sites. Anionic PAM products reduce erosion and sedimentation by targeting the smallest soil particles, fine silts, clays and colloidal materials (5-10 microns in size), which are difficult or impossible to control using conventional ESC measures. These smaller particles are commonly maintained or introduced on site as fill because they are easily compacted. Silt fence and sediment basins, only trap particles as small as 125 microns (sands and coarse silts) and >20 microns (silts), respectively. Thus, once liberated, the smallest particles remain in the water column, and may necessitate complex and expensive solutions to prevent violations and remediate property and environmental damage that may result if this material is transported off site in stormwater. In a recent three-year efficacy study on construction sites, Anionic PAM provided up to 70% reduction in runoff-sediment, and even better results when combined with conventional mulching and seeding measures.

Anionic PAM uses two mechanisms to affect these difficult to address particles. It preferentially increases aggregation of these small particles to improve soil stability and prevent soil detachment in the first place, and decreases the settling time of particles that become suspended to aid in their deposition within the site, thus improving runoff water quality. Additionally, Anionic PAM can increase soil pore volume and permeability, thus increasing infiltration and reducing the runoff quantity.

Anionic PAM is applied on site via two “dosing methods” (direct, passive), and is available in four media types (powder, powder dissolved in water [wet], emulsion, gel block). The powder, wet, and emulsion media are applied directly to short, steep slopes, and other exposed soil surfaces for soil stabilization, while gel blocks are “passively” used within a ditch or conveyance system for in situ water treatment above pre-constructed sediment ponds. Further, to optimize performance, preliminary site-specific assessment (soil and water testing) by a qualified manufacturer must be conducted to select media, additives, dosing rate, dosing method, and maintenance procedure tailored to site-specific soil characteristics, topography, hydrology, and type of erosion targeted.

Application of Anionic PAM to sites with problem soils in accordance with manufacturers guidance, this bulletin, and other regulatory programs, shows great promise for improving compliance with NPS requirements, specifically Minimum Standards 1 (soil stabilization) and 19 (stormwater management) of the Virginia Erosion & Sediment Control Regulations (4VAC50-30-40), and in turn, preventing degradation of off site property and water resources.

Applicability

Anionic PAM is intended for use on areas that contain **high amounts of fine silt, clay, or colloidal soils**. Anionic PAM is generally applicable where the timely establishment of vegetation may not be feasible, is absent or inadequate, or where topographic conditions, construction activities, or other forces limit the utility of conventional temporary sediment control practices alone. Anionic PAM may be beneficial to the following activities/areas:

- Staging areas
- Rough grading operations
- Balanced cut and fill earthwork
- Man-made or natural stormwater conveyances
- Haul roads
- Roadside ditches
- Soil stockpiles and borrow areas
- After final grade and before paving, final seeding, and planting
- Phased projects
- Sites having a winter shut down
- Other exposed areas that have not been adequately stabilized with vegetation or where other stabilization measures would interfere with construction activities or are otherwise ineffective/inefficient for the area or time of year.

*As further discussed in the **Application Restrictions** section, the proper type of Anionic PAM **must** only be applied in accordance with an approved plan/permit and on areas that ultimately drain to a pre-constructed sediment trap or basin prior to introduction to surface waters.*

Advantages & Limitations

Below is an inclusive list of common advantages and limitations that may apply to use of Anionic PAM. These issues should be carefully considered before applying Anionic PAM to a specific site.

Advantages

- Improves stability of problem soils to prevent soil detachment in the first place
- Provides quick stabilization where vegetation has yet to be established

- Promotes flocculation (reduces settling time) of smallest particles
- Increases soil pore volume and permeability, thus decreasing impervious cover
- Less obtrusive than some conventional measures - doesn't interfere with construction machinery/activity
- Convenient and easy to apply and store along with other soil amendments (fertilizer, mulch, etc.) with conventional seeding, mulching, or irrigation equipment
- Material is specifically designed for the soil, waters, and other on site characteristics
- May prevent costly repair and reshaping of rilling or failing slopes
- Re-application may not be necessary for several months if treated areas are mulched
- Reduces seed, pesticide, and fertilizer (phosphorus and nitrogen) losses that hinder vegetation establishment on site, increase costs, and promote nutrient and chemical loading offsite
- Non-toxic to aquatic biota
- Reduces windborne dust conditions
- May prevent water quality damages (TSS, turbidity), eutrophication, habitat destruction, stream channel erosion, sedimentation, and related remediation costs
- Reduces potential for violations of MS-1 and MS-19
- Less expensive in the long-term by requiring less mulch, seed, etc. and corrective actions/remediation

Disadvantages/Limitations

- Materials are "soil-specific," so you can not reuse extra supply or bulk order for multiple sites
- Requires site-specific testing that may take several days to complete
- Energy intensive process (mechanical mixing) may be required for proper dissolution of viscous products
- May enhance precipitation of fine sediments in downstream structures, and therefore, increasing maintenance requirements (removal of sediment/PAM complex from basins)
- Misuse (over use) by inexperienced parties that clog soils, thereby decreasing infiltration
- Are not effective when applied to pure sand or gravel with no fines, and when applied over snow cover
- Qualified manufacturers and distributors may not be currently available throughout the entire state
- Improper over-reliance on Anionic PAM, in lieu of proper conventional ESC measures
- May require engineers to consider Anionic PAM's impact on existing seeding/fertilizer, pond sizing, and other specifications
- Public concern over introduction of polymer products to the natural environment

Application Restrictions

To help ensure, safe, effective, and environmentally friendly application of Anionic PAM to construction sites, DCR has established four site restrictions to Anionic PAM application. Note a qualified manufacturer should be consulted to confirm a compliant and effective product is selected. It is suggested that applicants request references from manufacturers and/or contact appropriate public agencies to confirm qualifications before contracting service.

ALL ANIONIC PAM APPLICATIONS MUST COMPLY WITH THESE RESTRICTIONS.

(1) Material

Only Anionic PAM and Anionic PAM mixtures that comply with the following criteria may be used. The criteria listed below are generally included on the product label and/or Material Safety Data Sheet (MSDS).

- PAM copolymer formulation **must** be anionic (negatively charged), with a charge density of 8 to 35% by weight (15-18% is typical)
- Ultra high molecular weight of 6 to 24 mg/mole (preferably 12-15 mg/mole)
- Water-soluble, “linear,” or “non-crosslinked”
- Highest grade Anionic PAM (potable drinking water grad – PDWG), certified for compliance with ANSI/NSF Standard 60 and EPA and FDA residual acrylamide monomer (AMD) limits of 0.05% for drinking water/food treatment
- Non-combustible
- Does not change soil pH
- Expiration date included
- Must be accompanied by MSDS and toxicity information from the manufacturer that the Anionic PAM product and any required additives are non-toxic to aquatic biota (acute and chronic toxicity results using EPA protocols approved under the Clean Water Act at 40 CFR 136) **NOTE: Site-specific Anionic PAM product toxicity or efficacy testing is not required by DCR at this time. However, compliance with other regulatory programs/agencies may require this testing to ensure safe and compliant use on site.**
- **Must** be accompanied by manufacturers written instructions to ensure proper (1) Product and Site Preparation, (2) Application, (3) Maintenance/re-application, (4) Storage, and (5) Safety, in accordance with Occupational Health and Safety Administration (OSHA) and other applicable guidelines

NOTE: Cationic PAM (positively charged) shall **never** be used because of its toxicity to aquatic organisms at very low concentrations. When used properly, Anionic PAM has no measurable toxicity to humans, aquatic organisms, or plants. The high molecular weight Anionic PAM suggested herein present little concern for toxicity, as their molecules are so ultra large that they do not penetrate biological membranes. Additionally when Anionic PAM is introduced into waters containing sediments, humic acids, or other impurities, its effects are buffered to an even greater degree. Further, **acrylamide** (a known carcinogen) residuals found in very small amounts in PAM products is stringently regulated during manufacturing by EPA and FDA, so toxic concentrations do not reach the market.

(2) Site-Specific Testing and Instructions

Users **must** obtain site-specific soil and water testing and guidance from a qualified manufacturer to ensure that an (a) Anionic PAM product, (b) additives, and (c) application scheme are selected that is tailored to site-specific soil characteristics (type, aggregate size, organic content, ion content), topography, hydrology, and type of erosion targeted. Manufacturers generally provide this service at no cost. The final site-specific specifications, along with material specifications noted in item 1 above, should be provided to the plan-approving authority to be included with the ESC plan.

(3) Application Conditions

Anionic PAM **must always** be applied above a pre-constructed sediment trap or basin inflow structure and **never** be applied directly to:

- Slopes that flow directly into a wetland or state waters
- Sediment basins, traps, or other SWM ponds
- Wetlands or state waters

(4) Approvals and Permits

Anionic PAM use **must** conform to all federal, state, and local laws, rules, and regulations regarding use, discharge, and disposal of chemical materials.

- Site-specific specifications for Anionic PAM **must** always be consistent with this bulletin, included with the ESC plan, integrated with other conventional measures to maximize effectiveness, and approved by the appropriate plan-approving authority – **Anionic PAM should not be used IN LIEU of conventional measures!**
- Users **must** contact the appropriate local, regional, and/or state authority to confirm that Anionic PAM use will not conflict with any site-specific Virginia Discharge Elimination System Permits (VPDES), Virginia Water Protection Permits, or other discharge or wetlands permits

Application Considerations

As noted in the Materials subsection above, the manufacturer is required to provide written application instructions for Anionic PAM. The following are additional considerations and recommendations relating to the use of Anionic PAM that may enhance effectiveness or avoid problems.

EXCEPT FOR THE APPLICATION RESTRICTIONS IN THE PREVIOUS SECTION, MANUFACTURERS APPLICATION GUIDELINES MUST ALWAYS BE FOLLOWED AND TAKE PRECEDENCE OVER THESE ADDITIONAL CONSIDERATIONS.

General Considerations

- **DO NOT OVER APPLY ANIONIC PAM. Excessive application of Anionic PAM can lower infiltration rates or increase suspended solids in water. Note that application rates of Anionic PAM above those suggested by the manufacturer will not provide additional effectiveness. More is not better!**
- Published literature and guidance recommends that application of Anionic PAM in pure form (75%-90% active polymer) not exceed 10 lbs/acre per single application event, 200 lbs/batch, or 200 lbs/acre/year.
- Note that for Anionic PAM to work effectively there must be a source of “divalent cations.” Gypsum (CaCl₂) is a common source. The divalent cation source may be in the Anionic PAM mix, in the soil, or applied directly to the soil. Manufacturers soil tests should be used to determine whether additives are necessary.
- Care must be taken to prevent spills onto paved surfaces, as Anionic PAM may be very slippery. Skid protection should be employed in wet areas.
- Gloves should be worn whenever handling Anionic PAM and surfaces that contacted them.
- Consider all OSHA health and safety precautions and manufacturers instructions.

Direct Application Considerations

- Recent publications suggest that Anionic PAM application costs will range from \$107 - \$222/acre
- **Do not** add water to powdered Anionic PAM. Add Anionic PAM powder **slowly** to water to the desired concentration and mix for 3 to 5 minutes. If water is added to PAM, globs may form that can clog dispensers – this indicates incomplete dissolving of the Anionic PAM, and therefore, increases the risk of under-application.
- Including tackifiers, mulch, seed, and fertilizer in the final Anionic PAM mixture is recommended to improve performance and provide additional permanent protection beyond the useful life of the Anionic PAM. **However, Anionic PAM should always be the final additive to the mixture.**
- The Anionic PAM mixture should be prepared immediately prior to application as effectiveness decreases if too much time passes between mixing and application.
- Application to dry soil is preferred.
- May be sprayed on bare soil using standard irrigation equipment, hydroseeding/hydromulching equipment, water trucks, or other spraying devices that have a mechanical agitator, mixing apparatus, or hydrologic recirculation.
- Marking with tracer or colorant to visually track application is recommended.
- Use a minimum 30 ft. setback when applying near wetlands or surface waters.
- Procedures for application should ensure uniform coverage to the target area and avoid drift to non-target areas.
- Inhaling powdered Anionic PAM in large quantities may cause choking or difficulty breathing. Persons handling and mixing Anionic PAM should use a dust mask of a type recommended by the manufacturer.
- If Anionic PAM powder gets on skin or clothing, wipe off with a towel rather than washing with water.
- Limit exposure of the powder Anionic PAM supply, as air and sunlight degrade effectiveness in 3 months.

Passive Application Considerations

- Gel block media size and shape should be regulated to deliver the appropriate dosage within a particular conveyance – applicants should work with the manufacturer to ensure sediment removal.
- Gel blocks should generally be placed in the center of the ditch as close as possible to the active land-disturbing activities and an appropriate distance above the inflow of the sediment trap or basin to ensure adequate turbulence and mixing energy for flocculation in the downstream sediment trap or basin.
- Stakes, nylon mesh bags, wire cages, and other equipment used to maintain/protect the block within the conveyance should be installed in accordance with manufacturers directions.

Maintenance and Disposal

Degradation of PAMs in soil systems can be expected to occur as a result of mechanical degradation, chemical and biological hydrolysis, sunlight, salt, and temperature effects at a rate that has been estimated to be approximately 10% per year. However, these effects are accelerated in highly exposed areas. Anionic PAM may be reapplied in accordance with manufacturers instructions to disturbed areas after a 48-hour period. Reapplication is not required unless Anionic PAM treated soil is disturbed or turbidity or water quality show the need for an additional application. If PAM treated soil is left undisturbed, a reapplication may be necessary after 6-8 weeks. Further Anionic PAM applications may be required for steep slopes, highly silty and clayey soils, long grades, and high traffic or precipitation areas. **Note that if Anionic**

PAM is first applied to bare soil and then covered with mulch, a reapplication may not be necessary for several months. Continue to monitor areas to which Anionic PAM has been introduced after every precipitation event and until treated areas are permanently stabilized.

All equipment should be maintained to provide the application rates recommended by the manufacturer. Rinse all equipment used to mix and apply Anionic PAM thoroughly with water to avoid formation of residues.

Anionic PAM may enhance precipitation of fine sediments in downstream pipes, channels, and detention basins. Accordingly, these structures should be inspected periodically and sediment removed when it exceeds 10% of the structure's mean depth or in accordance with the clean out schedule recommended for the particular measure.

Recovered sediments containing Anionic PAM should be reused or disposed of in accordance with local, state, and Federal regulations. Anionic PAM is not listed in Federal hazardous waste regulations (Comprehensive Environmental Response, Compensation, and Liability Act of 1980, Public Law 96-510, as amended by the Superfund Amendments and Reauthorization Act of 1986, Public Law 99-499), or in the Virginia Hazardous Waste Management Regulations (9VAC20-60-12 et seq.). Accordingly, recovered sediments may be dewatered appropriately and used as a fill material, or alternatively, may be land applied if the sediment does not have the structural stability to act as fill.

Further Information

Requests for further information or questions regarding the application of Anionic PAM to construction sites in Virginia should be directed to qualified manufacturers or DCR's Central Office in Richmond, VA.

References

AGC of Washington Education Foundation. 2000. *Experimental BMP 5.0-PAM. Construction Site Erosion and Sediment Control Certification Course Manual*. Sections 4.1.1 – 4.1.5.

Applied Polymer Systems, Inc. (APS). 2000. Promotional materials and Material Safety Datasheets regarding Silt Stop (APS 630, 640, 705, 730, and 740) and Floc Log (APS 702, 703, 730, and 732) PAM products.

Georgia Soil and Water Conservation Commission. 2000. *Polyarylamide (PAM). Manual for Erosion and Sediment Control in Georgia*, 5th Edition. pp. 6-67 – 6-68.

Green, S.E. and D.E. Stott. 2001. *Polyacrylamide: A Review of the Use, Effectiveness, and Cost of a Soil Erosion Control Amendment*. Pp. 384-389. In: Sustaining the Global Farm. Selected Papers from the 10th International Soil Conservation Organization Meeting held May 24-29, 1999, Purdue University and the USDA-ARS National Soil Erosion Research Laboratory.

Lentz, R.D., T.D. Stieber, and R.E. Sojka. 2000. *Applying Polyacrylamide (PAM) to Reduce Erosion and Increase Infiltration Under Furrow Irrigation*. U.S. Department of Agriculture, Agricultural Research Service, Northwest Irrigation and Soils Research Lab. Adapted from: Lentz, R.D., T.D. Stieber, and R.E. Sojka. 1995. *Applying polyacrylamide (PAM) to reduce erosion and increase infiltration under furrow irrigation*. p. 79-92. In L.D. Robertson, P. Nolte, B. Vodraska, B. King, T. Tindall, R. Romanko, J. Gallian (ed.) Proc. Winter Commodity Schools - 1995. University of Idaho Cooperative Extension, Moscow, Idaho. Posted on USDA-ARS website.

Michigan Department of Environmental Quality, Surface Water Protection Division. Undated. *Technical Guidance for the Use of Polyacrylamides for Soil Erosion Control*.

Mostaghimi, K.A., K.A. Flahive, P.W. McClellan, A. Mendez, and D.H. Vaughn. 2000. *A Comparative Investigation of the Effectiveness of Polyacrylamide (PAM) for Erosion Control in Urban Areas*. Biological Systems Engineering Department, Virginia Tech, Blacksburg, VA. Unpublished report prepared for Virginia Department of Conservation and Recreation. (Includes extensive summary of current literature regarding PAM)

Natural Resource Conservation Service. 2001 *Anionic Polyacrylamide (PAM) Erosion Control*. Code 450. pp. 450-1– 450-3.

Oregon Department of Environmental Quality. 2000. *Best Management Practices for Storm Water Discharges Associated with Construction Activities, BMP #30 – Flocculants and Coagulants*. Construction BMPs Manual, Volume II. pp. 40 – 46.

Roa-Espinoza, A., G.D. Bubenzer, and E.S. Miyashita. 2000. *Sediment and Runoff Control on Construction Sites Using Four Application Methods of Polyacrylamide Mix*. Proceedings of the National Conference on Tools for Urban Water Resource Management and Protection. USEPA Office of Research and Development. EPA/625/R-00/001. pp. 278-283

Roa, A. 1997. *Are there Safety Concerns or Environmental Concerns with PAM?* Dane County Land Conservation Department.

Sojka, R.E.. 2001. *Potential Use of Polyacrylamide (PAM) in Australian Agriculture to Improve Off- and On-site Environmental Impacts and Infiltration Management*. Report to the Australian Land and Water Resource Research Development Council, the Institute for Sustainable Irrigated Agriculture, Goulburn-Murray Water, and USDA Agricultural Research Service. Posted on USDA-ARS website.

Sojka, R.E., D.L. Lentz, and D.L. Bjorneberg. 2001. Aase, J.K. *The PAMphlet: A concise guide for safe and practical use of polyacrylamide (PAM) for irrigation-induced erosion control and infiltration enhancement*. U.S. Department of Agriculture, Agricultural Research Service, Northwest Irrigation and Soils Research Lab. Posted on USDA-ARS website.

Sojka, R.E., and R.D. Lentz. 1996. *A PAM Primer: A brief history of PAM and PAM related issues*. U.S. Department of Agriculture, Agricultural Research Service, Northwest Irrigation and Soils Research Lab. Posted on USDA-ARS website.

Tobiason, E., K. Jenkins, E. Molash, E., and S. Rush. 2001. *Polymer Use and Testing for Erosion and Sediment Control of Construction Sites*. Erosion Control. January/February 2001. pp. 90-101.

U.S. Environmental Protection Agency. 2002. *Construction Site Storm Water Runoff Control – Chemical Stabilization*. Stormwater Phase II Menu of BMPs & Model Permits. EPA Office of Wastewater Managementwebpage.

U.S. Environmental Protection Agency. 1994. *Chemical Summary for Acrylamide*. Office of Pollution Prevention and Toxics. EPA-749-F-94-005a.

Virginia Administrative Code. 4VAC50-30. Virginia Erosion & Sediment Control Regulations.

Virginia Department of Conservation & Recreation. 1992. Virginia Erosion & Sediment Control Handbook. Chapter 3: State Minimum Standards & Specifications. Third Edition.

Washington Department of Ecology. 2000. *BMP C126: Polyacrylamide for Soil Erosion Protection*. Final Draft of Stormwater Manual for Western Washington, Volume II – Construction Stormwater Pollution Prevention. pp. 84-88.

Washington Department of Transportation. Undated. *WSDOT Draft Experimental BMP – Quality Assurance / Quality Control Plan: Polyacrylamide For Soil Erosion Control and Flocculation of Stormwater Detention Ponds at Highway Construction Sites*. WSDOT Highway Runoff Manual, Section 4.4. WAC173-270-030.6.a. pp. 1-28.

Washington Department of Transportation. 1997. *WSDOT Stormwater Management Plan*. Volume 5.3. pp. 45-51.

Wisconsin Department of Natural Resources. 2001. *Erosion Control – Land Application of Anionic Polyacrylamide*. Code 1050.

Erosion & Sediment Control Technical Bulletin No. 3

Construction Site Stabilization During Drought Conditions

Background

The Commonwealth is currently experiencing a severe drought. Consequently, Governor Warner issued Executive Order 33 on August 30, 2002 restricting water use, including the watering of existing lawns. In addition, certain localities may have stricter water conservation requirements during drought conditions.

Drought conditions make stabilization of land-disturbing activities more challenging. To stabilize construction sites, strict adherence to the Erosion and Sediment Control (ESC) Minimum Standards and the Virginia ESC Handbook, along with frequent site inspection, must be applied. Information on the Minimum Standards and the Virginia ESC Handbook are available on the website: <http://www.dcr.state.va.us/sw/e&s.htm>.

Benefits

Virginia frequently experiences hot, dry conditions during the summer months. Exceptionally dry conditions or drought and the possible ensuing water restrictions, intensify the need for water conservation. Measures used to stabilize construction sites, such as mulching and preserving existing vegetation, not only conserve water but also stabilize construction sites in an effective and economic manner.

The following four types of conservation tips assist in achieving successful site stabilization during extreme climates, while advocating the importance of water conservation during normal conditions.

Tips on Construction Site Stabilization During Drought Conditions

I. Preserve Established Vegetation on Construction Sites

- **Preserve Vegetation** - Maintain as much existing vegetation as possible during construction, including grass, shrubs, trees, and other ground cover, to reduce the need for new vegetation and to insulate new vegetation from heat.
- **Project Phasing** – Phase construction to disturb smaller areas and preserve vegetation. Phasing can maintain the existing vegetation and therefore reduce site exposure to drought and soil erosion. Phasing reduces the need and difficulties in stabilizing a large area of new vegetation at one time.

II. Establish New Vegetation to Stabilize Construction Sites While Conserving Water

- **Continue to Enforce Minimum Standard 1-** Permanent or temporary soil stabilization must be applied to denuded areas within seven days after final grade or if site will remain dormant for longer than 30 days, but less than one year.
- **Mulching** –Apply mulch consistently along with seed and tackifiers to increase available moisture, infiltration, and to provide insulation to soil and/or seed against heat.
- **Topsoiling** - Preserve and augment existing topsoil consistently with compost to increase water-holding capacity.

- **Surface Roughening in Conjunction with Mulching** – Add mulch to roughened slopes to increase infiltration and to protect seed from direct sun.
- **Hydroseeding in Conjunction with Mulching**– Supplement hydroseeding by applying mulch to bare ground first, then tack mulch by applying hydroseed during drought conditions to ensure seed protection from direct sun.
- **Drought Tolerant Seed** - Select site-specific seeding mixtures for the Virginia regions (Piedmont, Coastal, Appalachian, and Mountain Area) that are tolerant of drought conditions.

Permanent (Perennial) Stabilization Seed
Bermudagrass
Tall Fescues (Turf-Type or Kentucky 31)
Fine Fescues
Perennial Rye
Flatpea

Temporary (Annual) Stabilization Seed
Annual Rye
Foxtail Millet
German Millet

Avoid seed species that have poor drought tolerance, such as Kentucky Bluegrass, Annual Rye Grass, and White Clover.

- **Nurse Crop** - Add quick-growing annuals to permanent mixtures (nurse crop) to provide early protection and facilitate the establishment of one or two perennials in a mix. The addition of a nurse crop is a sound practice for soil stabilization, particularly on difficult sites where the development of permanent cover is likely to be slow, such as during severe drought conditions. The nurse crop germinates and grows rapidly, holding the soil until the slower-growing perennial seedlings become established.
- **Maintenance** – Strict adherence to ESC Minimum Standards must be applied during all climatic conditions to ensure site stabilization. Water, re-seed, re-mulch, and perform other maintenance for newly planted areas within 30 days of planting.
- **Conservation Watering Techniques** – Conserve when watering newly planted areas by following these techniques during all climatic conditions:
 - Water early in the morning or late at night to avoid evaporation
 - Avoid watering during windy weather
 - Use drip irrigation systems for bedded plants, trees and shrubs
 - Use a broom rather than a hose to clean walks and driveways
 - Plant native and/or drought tolerant grasses, ground covers, shrubs, and trees
 - Mulch to retain moisture in the soil
 - A once-a-week deep soaking of about 1- inch is sufficient for most grasses, trees, and shrubs
 - In most cases, watering is only necessary during the growing season, March through October

III. Stabilize Construction Sites Using Non-Vegetative Methods

- **Mulch** – Anchor mulch to disturbed areas to provide immediate stabilization in areas where vegetative establishment is difficult until the climate accommodates permanent vegetation establishment. Consider a variance to Minimum Standard 3- permanent vegetative cover shall be established on denuded areas not otherwise permanently stabilized.
- **Soil Stabilization Blankets & Matting** – Apply soil stabilization blankets and matting in areas where vegetative establishment is difficult until the climate accommodates permanent vegetation establishment. Consider a variance to Minimum Standard 3- permanent vegetative cover shall be established on denuded areas not otherwise permanently stabilized.
- **Sediment Clean-Up** – Give special attention to removing sediments from paved areas to limit street or truck washing.
- **Dust Control** – Give special attention to controlling dust by employing the following temporary measures during construction: vegetative cover; mulch; tillage; and spray-on adhesives. Sprinkling the site with water to control dust is a common practice (although not recommended during extreme drought conditions).

IV. Other Resources on Water Conservation

- <http://www.deq.state.va.us/info/conservewater.html>
- http://www.governor.state.va.us/Press_Policy/Executive_Orders/html/EO_33.html
- <http://www.naturalresources.state.va.us/Drought/WaterRestrictionsFAQ.cfm>
- <http://smv.org/savewater.html>
- <http://www.newport-news.va.us/wwdept/conserv/conserv.htm>
- <http://www.h2ouse.org/>

Erosion & Sediment Control Technical Bulletin No. 4

Nutrient Management for Development Sites

PRINCIPLE

This Erosion & Sediment Control Technical Bulletin updates the vegetative cover standards and specifications 3.31 Temporary Seeding, 3.32 Permanent Seeding, 3.33 Sodding, and 3.34 Bermudagrass & Zoysiagrass of the *1992 Virginia Erosion and Sediment Control Handbook*, in accordance with the *1995 Virginia Nutrient Management Standards and Criteria*. Specifically, the vegetation standards and specifications have been updated to reflect that no more than one (1) pound of water soluble nitrogen per 1,000 square feet is to be applied on construction sites in a 30 day period. Attached are one-page updates to the vegetative cover standards and specifications, which provide updated fertilizer and lime rates and the seeding schedules for the different physiographic regions of Virginia.

This document also discusses the need to ensure healthy vegetative growth by promoting a fertile soil as a crucial step in the establishment of vegetation, which can reduce the amount of nutrients (fertilizers) required to maintain a good vegetative cover.

THE IMPORTANCE OF URBAN NUTRIENT MANAGEMENT

Nutrients in urban runoff have been identified as being a significant contributor to the decline of the Chesapeake Bay, as well as Virginia's rivers, lakes, streams and groundwater. Improper timing or over application of plant nutrients is a major cause of non-point source pollution that can result in the impairment of Virginia's groundwater and surface waters. Runoff that carries nitrogen or phosphorus can lead to the increased growth of algae and aquatic weeds, deoxygenation, and reduced water clarity, which degrades water quality and stresses underwater plant and animal life.

Typical land development practices degrade soil quality and make it difficult to establish lawns and landscaped areas. In the course of development, soil rich in organic material is often stripped, compacted, buried under subsoil, or removed and replaced with shallower depths of lower quality, imported soil or fill material. Properly establishing an appropriate and uniform vegetative cover as quickly as possible on denuded sites plays an extremely important role in reducing erosion and minimizing sedimentation to downstream waterways.

Nutrient management on construction sites helps prevent the pollution and degradation of state waters. Not only are there economic benefits of applying less fertilizer, nutrient reduction can be achieved by applying fertilizer more efficiently. In short, nutrient management is an environmentally and economically sound practice for restoring waters in Virginia and involves the implementation of practices that promote vegetative cover in developing areas while protecting water quality.

ESTABLISHMENT OF VEGETATIVE COVER

Developing a fertile soil is a crucial step in the establishment of vegetation, which can reduce the amount of fertilizer required to maintain good vegetative cover. A fertile soil has the capacity to supply the nutritional needs of the plants being established. Good soil quality characteristics include good soil texture, adequate nutrients available for plant growth, good moisture holding capacity, and the appropriate soil acidity/alkalinity balance (pH). The following is a discussion of the steps needed to ensure good vegetative growth.

1. Soil Tests

Soil tests are extremely important and should be conducted on every site. Soil tests provide specific information on the amounts of phosphorus, potassium, calcium and magnesium available for plant uptake and recommends additional amounts as required. Soil tests are crucial for determining the amount of lime needed to obtain an appropriate soil pH for the vegetation being established. Soil test results include recommendations specific to the site and vegetation being grown. Soil tests recommend the amount of plant nutrients and lime needed to promote and maintain good plant growth. Soil tests may be performed by the Cooperative Extension Service Soil Testing Laboratory at VPI & SU, or by a reputable commercial laboratory. Also note that County Extension offices have soil testing supplies and information.

Soil tests are not used to determine nitrogen needs. Nitrogen is applied based upon established requirements for the plant to be grown, season of growth, and intended use.

2. Surface Roughening

Provide a rough soil surface by stair-step grading, grooving, or tracking the soil to be vegetated or by leaving slopes in a roughened condition by not fine-grading, in accordance with the *1992 Virginia Erosion & Sediment Control Handbook* (Std & Spec 3.29). Seed germination is difficult with compacted soils. Rough, loose soil surfaces helps prevent the loss of lime and fertilizer due to runoff, increases water infiltration, and provides seed coverage, which aids in seed germination.

3. Soil Amendments & Soil Quality

Materials such as sand, vermiculite, peat, and compost may be added to soil to modify texture, improve structure and increase the moisture holding capacity. It is also recommended to conserve existing soil quality by preserving and reapplying topsoil in accordance with the *1992 Virginia Erosion & Sediment Control Handbook* (Std & Spec 3.30). Areas that have been compacted, or where duff or underlying topsoil is removed, should be amended with compost to improve soil quality.

4. Lime

Adjusting the soil pH between 6.25 to 6.5 is extremely important for grass establishment, especially in the acidic soils of Virginia. A soil test is necessary to determine the actual amount of lime required to adjust the soil pH of denuded sites. However, when a soil test has not been performed, apply 2-tons/acre (90 pounds per 1,000 square feet) of pulverized agricultural grade limestone.

5. Fertilizer

Never apply more than 1 pound of water soluble nitrogen per 1,000 square feet within a 30 day period. Nitrogen should be applied based upon established requirements of the plant to be grown, season of growth, and intended use. Establishing a uniform dense vegetative cover with a good root system reduces the potential for pollution by decreasing erosion and runoff, increasing the plants ability for nutrient uptake, and reducing pesticide use. A detailed discussion on fertilizer use is provided in the 'Updated Fertilizer Specifications and Rates for Establishment' section of this bulletin.

6. Incorporation

Incorporate the lime and fertilizer into the top 4 – 6 inches of the soil by discing or by other means. Incorporation reduces the potential nutrient loss due to runoff, as well as significantly increasing the success of establishing a vegetative cover. When surface roughening does not occur prior to the application of lime and fertilizer, ‘mix’ the lime and fertilizer into the soil, at least 4 inches, by the methods described in the *1992 Virginia Erosion and Sediment Control Handbook* (Std & Spec 3.29).

When incorporation does not occur, and fertilizer and lime is applied directly to a smooth surface, the phosphorus (P2O5) application rate must be reduced by half because of the limited contact area with soil and the risk of nutrients being lost in runoff.

7. Seeding

Selection of plants is based on climate, topography, soils, land use and the planting season. The *1992 Virginia Erosion and Sediment Control Handbook* vegetative cover standards and specifications 3.31 Temporary Seeding, 3.32 Permanent Seeding, 3.33 Sodding, and 3.34 Bermudagrass & Zoysiagrass, describe in detail the specifications for plant selection. In addition, attached are one-page updates to the vegetative cover standards and specifications, which provide updated fertilizer and lime rates and the seeding schedules for the different physiographic regions of Virginia.

8. Mulching

The application of mulch to the soil surface, for both temporary and permanent seeding, is one of the most effective means of controlling runoff and erosion on disturbed land. All permanent seeding must be mulched immediately upon completion of seed application. It is especially important to mulch liberally in mid-summer and prior to winter. Mulching prevents erosion, and thereby pollution, by protecting the soil surface and fostering the growth of vegetation by increasing the moisture content and providing insulation from extreme temperatures. The *1992 Virginia Erosion and Sediment Control Handbook* (Std & Spec 3.35) details the mulch specifications and includes a list of the typical materials used to mulch (for example straw, wood chips, and fiber mulch).

9. Hydroseeding

Hydroseeding is a mechanical method of applying seed, fertilizer, and mulch to land development sites in one step. This method is efficient in providing an immediate cover to denuded sites; however, the surface must be carefully prepared in order for successful seed germination. Hydroseed on rough, loose surfaces only. Roughen the surface prior to application of hydroseeding, per the specification above and in accordance with the *1992 Virginia Erosion & Sediment Control Handbook* (Std & Spec 3.29). Although proper soil pH is crucial in establishing good vegetative cover, lime is usually not included in the hydroseed mix. Therefore, lime should be incorporated into the soil as needed when preparing the site for hydroseeding.

To avoid poor seed germination as a result of seed damage during hydroseeding, it is recommended that if the machinery breaks down from 30 minutes to 2 hours, 50% more seed must be added to the tank. Beyond 2 hours, a full rate of new seed is usually necessary.

UPDATED FERTILIZER SPECIFICATIONS AND RATES FOR ESTABLISHMENT

Plant nutrients should be applied based upon established requirements of the plant to be grown, season of growth, and intended use, as specified in the *1992 Virginia Erosion and Sediment*

Control Handbook (Std & Spec 3.31, 3.32, 3.33, and 3.34). The timing and rate of fertilizer application depends on the type of grass. There are basically two types of grasses, warm and cool season grasses. Warm season grasses (Bermuda, Zoysia) are those that go dormant in the winter. Cool season grasses (Fescue, Bluegrass) are those that stay green year round.

1. Recommended Season for Applying Nitrogen Fertilizers

The earliest spring application of nitrogen for **cool season** grasses is six weeks prior to the last average frost date (for example, February 6 for Virginia Beach and March 1 for Roanoke). The latest fall application of nitrogen for **cool season** grasses is six weeks after the first average frost date (for example, December 29 for Virginia Beach and December 1 for Roanoke).

The earliest spring application of nitrogen for **warm season** grasses is the last average frost date for the region (for example, March 20 for Virginia Beach and April 15 for Roanoke). The latest fall application of nitrogen for **warm season** grasses is 30 days prior to the average first frost date for the region (for example, October 15 for Virginia Beach and September 20 for Roanoke).

2. Per Application Rates

Phosphorus (P) and potassium (K) fertilizer requirements should be determined by a soil test. Never apply more than one (1) pound of water soluble nitrogen per 1,000 square feet within a 30 day period. The following table itemizes the fertilization rate revisions to standards and specifications 3.31 Temporary Seeding, 3.32 Permanent Seeding, 3.33 Sodding, and 3.34 Bermudagrass & Zoysiagrass Establishment.

Summary of Fertilizer Specification Revisions for Establishment of Turf

Standards & Specifications		2003 Urban Nutrient Management Technical Bulletin
3.31 Temporary Seeding		10-10-10 fertilizer applied at a rate of 450 lbs. / acre or 10 lbs. / 1,000 ft²
3.32 Permanent Seeding	Mixed Grasses & Legumes	10-20-10 fertilizer applied at a rate of 500 lbs. / acre or 12 lbs. / 1,000 ft²
	Legume stands only	Apply the equivalent of 100 lbs. of phosphate (P ₂ O ₅) and 100 lbs. of Potash (K ₂ O) per acre. NO NITROGEN (N)
	Grass stands only	10-20-10 fertilizer applied at a rate of 500 lbs. / acre or 12 lbs. / 1,000 ft²
3.33 Sodding		10-10-10 fertilizer applied at a rate of 450 lbs. / acre or 10 lbs. / 1,000 ft² . NOTE: For cool season grasses apply fertilizer in fall or spring. For warm season grasses apply the fertilizer in late spring or summer only.
3.34 Bermudagrass & Zoysiagrass Establishment		10-10-10 fertilizer applied at a rate of 500 lbs. / acre or 12 lbs. / 1,000 ft² . Apply additional phosphorus and potassium 30-60 days later based on the soil test. Apply an additional equivalent of 1 lb./1,000 ft ² of nitrogen when the P & K are applied.

3. Using Fertilizer Analysis to Calculate Nitrogen Rates

All fertilizer packages have three numbers present on the package (for example, 10-10-10 or 16-4-8). These three numbers indicate the percentage of nitrogen (N), phosphorus (P₂O₅), and potash (K₂O) present by weight which is called the N-P-K ratio. For example, a 20 pound bag of 10-6-4 is 10 percent nitrogen (2 lb. of N), 6 percent phosphate (1.2 lb. of P₂O₅), and 4 percent potash (0.8 lb. of K₂O) the remaining is inert material to facilitate even application of fertilizer.

The Virginia nutrient management recommendation is to apply no more than 1 lb. of nitrogen per 1,000 square feet within a 30 day period. A fertilization rate of 1 lb. of nitrogen per 1,000 square feet can be obtained for any site by using the fertilizer analyses on the bag and knowing the area of application.

Fertilizer Bag Reads:	Amount to Fertilizer to Apply 1 lb. of nitrogen / 1000 sq.ft.
6-2-0	16.6 lb.
10-10-10	10 lb.
16-4-8	6.2 lb.
20-5-5	5 lb.
22-3-14	4.5 lb.
29-3-7	3.4 lb.

4. Use of Slowly Available Forms of Nitrogen

Fertilizer bags will state the source or category from which the nitrogen is derived. Nitrogen fertilizers have two categories: Water Soluble Nitrogen (i.e., all nitrogen is immediately available); and Slowly Available Nitrogen (i.e., nitrogen is available over an extended period of time). The nitrogen source impacts how grass is fertilized and the rate and timing of application of fertilizer.

Choose a fertilizer that has some amount of Slowly Available Nitrogen (SAN). Slowly available nitrogen fertilizers make nitrogen available a little at a time, the way most grasses need it, which reduces both the potential of excess nutrients in runoff and the leaching potential of excess nutrients into groundwater. Sources of SAN are usually stated on the label. It may be stated as % Water Insoluble Nitrogen (WIN), sulfur-coated urea, natural organic nitrogen or other controlled release materials used to coat the fertilizer. The % WIN is usually stated on the fertilizer container, if the % WIN is not listed, assume that all the nitrogen in the fertilizer is water soluble and immediately available. As a general guideline, if the fertilizer has 50% WIN or less, it should be applied in the same manner as readily available nitrogen. If the fertilizer is 50% WIN or greater, it should be applied as a SAN.

UPDATED FERTILIZER SPECIFICATIONS AND RATES FOR MANAGEMENT

1. Application of Fertilizer for Maintenance

Apply fertilizer when grass is actively growing and can utilize the nutrients. Summer is best for warm season grasses (zoysiagrass and bermudagrass) while the fall months are best for cool season grasses (tall fescue, Kentucky bluegrass, perennial ryegrass).

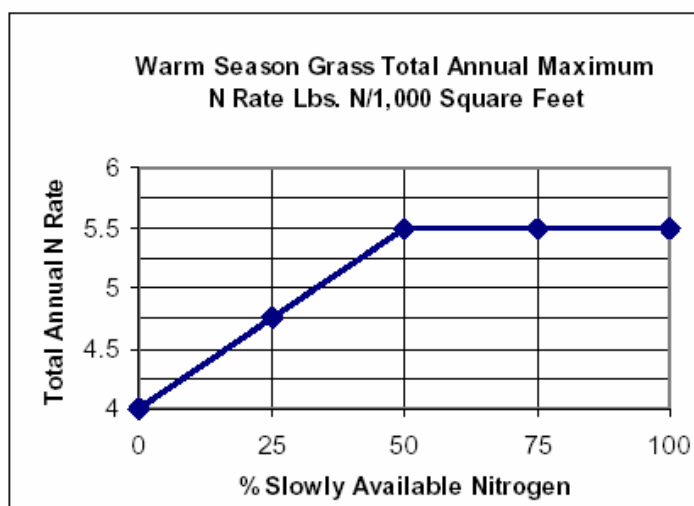
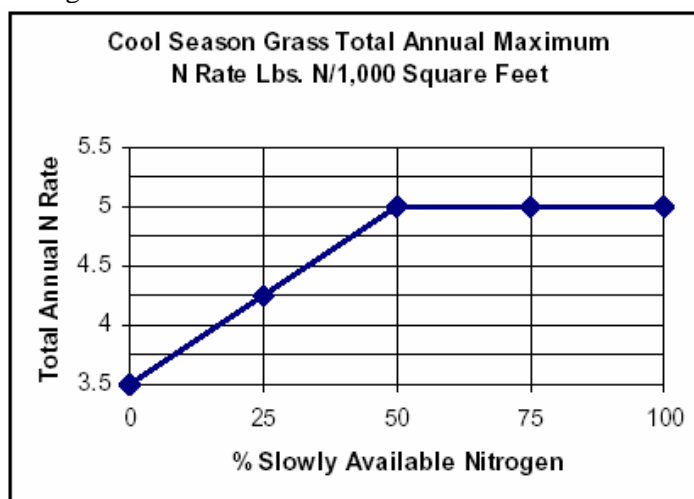
2. Annual Application Rates

A. When applying 100% Water Soluble Nitrogen sources (those that have all the nitrogen immediately available for plant use), the following rates apply:

- Never apply more than one (1) pound of water soluble nitrogen per 1,000 square feet within a 30 day period
- No more than 3.5 lbs. of nitrogen per 1,000 square feet annually on **cool season** grass.
- No more than 4.0 lbs. of nitrogen per 1,000 square feet annually on **warm season** grass.

B. When applying slowly available nitrogen (SAN, WIN, sulfur-coated urea, natural organic nitrogen or other controlled release materials), total annual nitrogen application rates may be adjusted incrementally by referring to the following figure. The maximum annual nitrogen rates when using 50% or greater SAN is as follows:

- No more than 5.0 lbs. of nitrogen per 1,000 square feet annually on **cool season** grass.
- No more than 5.5 lbs. of nitrogen per 1,000 square feet annually on **warm season** grass.



C. When applying maintenance fertilizer on established sod,

Pounds of nitrogen per 1,000 sq. ft. if the fertilizer is less than 50 percent WIN				
Month	Type of Grass			
	Tall Fescue Perennial Rye	Kentucky Bluegrass	Bermudagrass	Zoysiagrass
September	1	1	0	0
October	1	1	0	0
Early November	0	0	0	0
April	0	0	0	0
May	0-0.5	0-0.05	1	1
June	0	0	1	0
July/August	0	0	0	1
Yearly Lbs. N/1000 sf	2.5	2.5	2	2
Pounds of nitrogen per 1,000 sq. ft. if the fertilizer is more than 50 percent WIN				
Month	Type of Grass			
	Tall Fescue Perennial Rye	Kentucky Bluegrass	Bermudagrass	Zoysiagrass
August 15	1.5	1.5	0	0
October 1	1.5	1.5	0	0
April	0	0	1.5	1.5
May 15	0	0	0	0
June	0	0	1.5	1.5
Yearly Lbs. N/1000 sf	3	3	3	3

TABLE 3.31-B
(Revised June 2003)
TEMPORARY SEEDING SPECIFICATIONS
QUICK REFERENCE FOR ALL REGIONS

<u>SEED</u>		
APPLICATION DATES	SPECIES	APPLICATION RATES
Sept. 1 - Feb. 15	50/50 Mix of Annual Ryegrass (lolium multi-florum) & Cereal (Winter) Rye (Secale cereale)	50 -100 (lbs/acre)
Feb. 16 - Apr. 30	Annual Ryegrass (lolium multi-florum)	60 - 100 (lbs/acre)
May 1 - Aug. 31	German Millet	50 (lbs/acre)

<u>FERTILIZER & LIME</u>
<ul style="list-style-type: none"> ● Apply 10-10-10 fertilizer at a rate of 450 lbs. / acre (or 10 lbs. / 1,000 sq. ft.) ● Apply Pulverized Agricultural Limestone at a rate of 2 tons/acre (or 90 lbs. / 1,000 sq. ft.) <p>NOTE:</p> <p>1 - A soil test is necessary to determine the actual amount of lime required to adjust the soil pH of site.</p> <p>2 - Incorporate the lime and fertilizer into the top 4 – 6 inches of the soil by disking or by other means.</p> <p>3 - When applying Slowly Available Nitrogen, use rates available in <u>Erosion & Sediment Control Technical Bulletin # 4, 2003 Nutrient Management for Development Sites</u> at http://www.dcr.state.va.us/sw/e&s.htm#pubs</p>

TABLE 3.32-C
(Revised June 2003)
PERMANENT SEEDING SPECIFICATIONS FOR APPALACHIAN/MOUNTAIN AREA

SEED¹		
LAND USE	SPECIES	APPLICATION RATES
<u>Minimum Care Lawn</u> (Commercial or Residential)	Tall Fescue ¹	90-100%
	Perennial Ryegrass ²	0-10%
	Kentucky Bluegrass ¹	0-10%
		TOTAL: 200-250 lbs.
<u>High-Maintenance Lawn</u>	Minimum of three (3) up to five (5) varieties of Kentucky Bluegrass from approved list for use in Virginia ¹	TOTAL: 125 lbs.
<u>General Slope (3:1 or less)</u>	Tall Fescue ¹	128 lbs.
	Red Top Grass or Creeping Red Fescue	2 lbs.
	Seasonal Nurse Crop ³	20 lbs.
		TOTAL: 150 lbs.
<u>Low-Maintenance Slope</u> (Steeper than 3:1)	Tall Fescue ¹	108 lbs.
	Red Top Grass or Creeping Red Fescue	2 lbs.
	Seasonal Nurse Crop ³	20 lbs.
	Crownvetch ⁴	20 lbs.
		TOTAL: 150 lbs.

1 - When selecting varieties of turfgrass, use the Virginia Crop Improvement Association (VCIA) recommended turfgrass variety list. Quality seed will bear a label indicating that they are approved by VCIA. A current turfgrass variety list is available at the local County Extension office or through VCIA at 804-746-4884 or at <http://sudan.cses.vt.edu/html/Turf/turf/publications/publications2.html>

2 - Perennial Ryegrass will germinate faster and at lower soil temperatures than Tall Fescues, thereby providing cover and erosion resistance for seedbed.

3 - Use seasonal nurse crop in accordance with seeding dates as stated below:

March, April - May 15 th	Annual Rye
May 16 th - August 15 th	Foxtail Millet
August 16 th - September, October	Annual Rye
November - February	Winter Rye

4 - All legume seed must be properly inoculated. If Flatpea is used, increase to 30 lbs/acre. If Weeping Lovegrass is used, include in any slope or low maintenance mixture during warmer seeding periods, increase to 30 -40 lbs/acre.

FERTILIZER & LIME

- Apply 10-20-10 **fertilizer** at a rate of **500 lbs. / acre** (or 12 lbs. / 1,000 sq. ft.)
- Apply **Pulverized Agricultural Limestone** at a rate of 2 tons/acre (or 90 lbs. / 1,000 sq. ft.)

NOTE:

- A soil test is necessary to determine the actual amount of lime required to adjust the soil pH of site.
- Incorporate the lime and fertilizer into the top 4 – 6 inches of the soil by disking or by other means.
- When applying Slowly Available Nitrogen, use rates available in Erosion & Sediment Control Technical Bulletin # 4, 2003 Nutrient Management for Development Sites at <http://www.dcr.state.va.us/sw/e&s.htm#pubs>

TABLE 3.32-D
(Revised June 2003)
PERMANENT SEEDING SPECIFICATIONS FOR PIEDMONT AREA

SEED ¹		
LAND USE	SPECIES	APPLICATION PER ACRE
<u>Minimum Care Lawn</u> (Commercial or Residential)	Tall Fescue ¹	95-100%
	Perennial Ryegrass	0-5%
	Kentucky Bluegrass ¹	0-5%
		TOTAL: 175-200 lbs.
<u>High-Maintenance Lawn</u>	Tall Fescue ¹	TOTAL: 200-250 lbs.
<u>General Slope (3:1 or less)</u>	Tall Fescue ¹	128 lbs.
	Red Top Grass or Creeping Red Fescue	2 lbs.
	Seasonal Nurse Crop ²	<u>20 lbs.</u>
		TOTAL: 150 lbs.
<u>Low-Maintenance Slope</u> (Steeper than 3:1)	Tall Fescue ¹	108 lbs.
	Red Top Grass or Creeping Red Fescue	2 lbs.
	Seasonal Nurse Crop ²	20 lbs.
	Crownvetch ³	<u>20 lbs.</u>
		TOTAL: 150 lbs.
1 - When selecting varieties of turfgrass, use the Virginia Crop Improvement Association (VCIA) recommended turfgrass variety list. Quality seed will bear a label indicating that they are approved by VCIA. A current turfgrass variety list is available at the local County Extension office or through VCIA at 804-746-4884 or at http://sudan.cses.vt.edu/html/Turf/turf/publications/publications2.html		
2 - Use seasonal nurse crop in accordance with seeding dates as stated below:		
	February 16 th - April	Annual Rye
	May 1 st - August 15 th	Foxtail Millet
	August 16 th - October	Annual Rye
	November - February 15 th	Winter Rye
3 - Substitute Sericea lespedeza for Crownvetch east of Farmville, VA (May through September use hulled seed, all other periods, use unhulled Sericea). If Flatpea is used, increase rate to 30 lbs./acre. If Weeping Lovegrass is used, include in any slope or low maintenance mixture during warmer seeding periods, increase to 30 -40		

FERTILIZER & LIME

- Apply 10-20-10 **fertilizer** at a rate of **500 lbs. / acre** (or 12 lbs. / 1,000 sq. ft.)
- Apply **Pulverized Agricultural Limestone** at a rate of **2 tons/acre** (or 90 lbs. / 1,000 sq. ft.)

NOTE:

- A soil test is necessary to determine the actual amount of lime required to adjust the soil pH of site.
- Incorporate the lime and fertilizer into the top 4 – 6 inches of the soil by disking or by other means.
- When applying Slowly Available Nitrogen, use rates available in Erosion & Sediment Control Technical Bulletin # 4, 2003 Nutrient Management for Development Sites at <http://www.dcr.state.va.us/sw/e&s.htm#pubs>

TABLE 3.32-E
(Revised June 2003)
PERMANENT SEEDING SPECIFICATIONS FOR COASTAL PLAIN AREA

<u>SEED¹</u>		
LAND USE	SPECIES	APPLICATION RATES
<u>Minimum Care Lawn</u> (Commercial or Residential)	Tall Fescue ¹ or	175 - 200 lbs.
	Bermudagrass ¹	75 lbs.
<u>High-Maintenance Lawn</u>	Tall Fescue ¹ or	200-250 lbs.
	Bermudagrass ¹ (seed) or Bermudagrass ¹ (by other vegetative establishment method, see Std. & Spec. 3.34)	40 lbs. (unhulled) 30 lbs. (hulled)
<u>General Slope (3:1 or less)</u>	Tall Fescue ¹ Red Top Grass or Creeping Red Fescue Seasonal Nurse Crop ²	128 lbs. 2 lbs. 20 lbs.
		TOTAL: 150 lbs.
<u>Low-Maintenance Slope</u> (Steeper than 3:1)	Tall Fescue ¹ Bermudagrass ¹ Red Top Grass or Creeping Red Fescue Seasonal Nurse Crop ² Sericea Lespedeza ³	93-108 lbs. 0-15 lbs. 2 lbs. 20 lbs. 20 lbs.
		TOTAL: 150 lbs.

1 - When selecting varieties of turfgrass, use the Virginia Crop Improvement Association (VCIA) recommended turfgrass variety list. Quality seed will bear a label indicating that they are approved by VCIA. A current turfgrass variety list is available at the local County Extension office or through VCIA at 804-746-4884 or at <http://sudan.cses.vt.edu/html/Turf/turf/publications/publications2.html>

2 - Use seasonal nurse crop in accordance with seeding dates as stated below:

February, March - April	Annual Rye
May 1 st - August	Foxtail Millet
September, October - November 15 th	Annual Rye
November 16 th - January	Winter Rye

3 - May through October, use hulled seed. All other seeding periods, use unhulled seed. If Weeping Lovegrass is used, include in any slope or low maintenance mixture during warmer seeding periods, increase to 30 -40 lbs/acre.

FERTILIZER & LIME

- Apply 10-20-10 **fertilizer** at a rate of **500 lbs.** / acre (or 12 lbs. / 1,000 sq. ft.)
- Apply **Pulverized Agricultural Limestone** at a rate of 2 tons/acre (or 90 lbs. / 1,000 sq. ft.)

NOTE:

- A soil test is necessary to determine the actual amount of lime required to adjust the soil pH of site.
- Incorporate the lime and fertilizer into the top 4 – 6 inches of the soil by disking or by other means.
- When applying Slowly Available Nitrogen, use rates available in Erosion & Sediment Control Technical Bulletin # 4, 2003 Nutrient Management for Development Sites at <http://www.dcr.state.va.us/sw/e&s.htm#pubs>